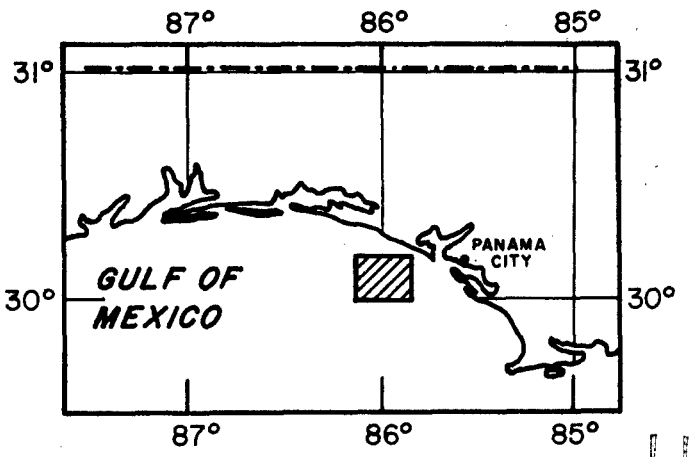
IR NO. 70-9

INFORMAL REPORT

# OCEANOGRAPHIC CRUISE SUMMARY PANAMA CITY, FLORIDA, JULY AND AUGUST 1969






MARCH 1970





NAVAL OCEANOGRAPHIC OFFICE
WASHINGTON, D.C. 20390

# INFORMAL REPORT

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ABSTRACT

The U.S. Naval Oceanographic Office (NAVOCEANO) was requested by the Naval Research Laboratory (NRL) to provide oceanographic support for an underwater acoustic experiment during July and August 1969. The experiment was conducted about 15 miles southwest of Panama City, Florida, from USNS J.W. GIBBS (T-AGOR 1). The objective of the NAVOCEANO survey was to determine the sound speed of the water column when requested by NRL. NAVOCEANO data were collected from 14 Nansen stations, 26 velocimeter lowerings, 77 bathythermograph lowerings, and 2 bottom samples.

Sound speeds were computed from temperature and salinity data and measured with a velocimeter. Agreement between the two methods was generally good.

The measured parameters revealed a continuously changing water column during the survey. Minimum sound speeds fluctuated about 7 m/sec from the beginning to the end of the survey.

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This report has been reviewed and is approved for release as an UNCLASSIFIED Informal Report.

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Director, Nearshore Surveys Division

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## I. INTRODUCTION

The U.S. Naval Oceanographic Office was requested by the Naval Research Laboratory (NRL) to provide oceanographic support for an NRL underwater acoustic experiment during July and August 1969. The experiment was conducted about 15 miles southwest of Panama City, Florida, near STAGE I (a Texas Tower). The coastal waters in this area are influenced by local runoff, precipitation, and wind patterns as well as prevailing currents, solar radiation, and the waters of the Gulf of Mexico. Two previous investigations have been made in this area by Texas A&M College: The ALASKA was the platform used in 1951, and the ALAMINOS in 1966. From these studies and other Gulf of Mexico data which are on file in the National Oceanographic Data Center (NODC), a literature survey was prepared by the Naval Oceanographic Office (1967) which presents the following general data on this area:

- Mean surface temperatures of the west Florida shelf waters increase in summer from <82°F (27.78°C) in June to 84°F (28.89°C) in September.
- Mean surface salinities of the sea waters increase from 33.00 o/oo in spring to almost 36.00 o/oo in autumn.
- Mean surface density increases to the south from May through August.

## II. OBJECTIVES OF THE CRUISE

The principal objective of the NRL survey was to measure the intensities of individual propagation modes as functions of range, depth, frequency, and state of sea. The objective of the Naval Oceanographic Office (NAVOCEANO) support survey (Operation Number 920002) was to calculate the sound speed of the water column when requested by the NRL senior scientist. Temperatures were to be obtained with a bathythermograph (BT), and water samples for salinity determination were to be obtained with Nansen bottles. Sound speeds were to be hand computed from the temperature and salinity data and to be measured with a velocimeter.

## III. NARRATIVE OF THE CRUISE

The survey was conducted in July and August 1969 aboard USNS J.W. GIBBS (T-AGOR 1). Mr. K.B. Peery was the NAVOCEANO representative. The ship departed Miami, Florida, on 18 July, and survey operations were begun on 21 July. During the period 21 July to 2 August, data were collected from 14 Nansen stations, 26 velocimeter lowerings, 67 BT lowerings, and 2 bottom samples.

In addition, 10 BT's were taken by NRL personnel on STAGE I. Figure 1 shows the locations where these data were taken. Table I presents a summary of the data collected.

## IV. METHODS OF COLLECTION AND ANALYSIS

### A. Temperature.

Water temperatures were measured with 200-foot BT's and six deep sea protected reversing thermometers that were attached to Nansen bottles. The accepted temperature values were obtained from the BT traces. The reversing thermometers, used mainly to validate BT temperatures, were used both singly and in pairs at selected depths. The BT slides were read at 5-foot intervals, and the temperatures are considered accurate to $\pm$0.1°F (0.06°C).

### B. Salinity.

Water samples for salinity analysis were obtained with Nansen bottles. These samples were analyzed aboard ship with an Industrial Instruments portable induction salinometer, Model RS-7B, Serial 22490, in accordance with NAVOCEANO's oceanographic instruction manual (NAVOCEANO, 1968). Salinities are considered accurate to $\pm$0.01 o/oo. Where salinity sample depths did not coincide with BT temperature depths, values were interpolated.

### C. Depth.

Maximum water depth in the area of operation was 108 feet (33 meters). Depths of the BT temperature observations were determined from the BT trace and grid, and then corrections applied. To determine depth corrections, the BT wire was measured and marked at 25, 50, 75, and 100 feet. The BT then was lowered to each of these depths, and the slide and grid were checked for depth accuracy. Corrections in addition to the surface correction were -1 foot below 60 feet, -2 feet below 75 feet, and -3 feet below 90 feet. BT temperature depths are considered accurate to $\pm$1 foot.

Nansen cast sampling depths were obtained from meter wheel readings. Wire angles were zero. The meter wheel was checked by measuring the wire as it payed out and by marking the wire with spray paint. Paint marks were checked against the meter wheel reading during each Nansen cast. One bottle was always attached approximately 1 meter above the lead weight, and the weight was allowed to touch bottom on each cast. On most casts, the 12 Nansen bottles available usually were attached at 3-meter intervals; but on some casts, several bottles were attached at 1.5-meter intervals to better delineate the water structure. On two stations, a second cast with six bottles was put down to obtain additional samples in the water column. On these second casts, two bottles were lowered to depths sampled by the first

cast to obtain duplicate samples. Nansen cast depths are considered to be within ±1 foot of the true sampling depth.

L. Sound Speed.

1. Computed. Sound speed was computed by two methods with Wilson's equations from BT temperature and depth and Nansen cast salinity: (1) Sound speed tables (NAVOCEANO, 1962), and (2) Wilson's equations that were modified for shallow water and programmed on a LOCI computer.

2. Measured. Sound speed was measured with an A.C.F. Industries Model TR-4-D(M-4) velocimeter. The cable used to lower the instrument was measured and marked at 5-foot intervals. The velocimeter then was lowered to the surface, 5 feet, 10 feet, etc., and at each depth a counter reading, which could be converted to sound speed, was manually recorded. A conversion factor of 206.62 was used.

E. Bottom Sediments.

Two bottom samples were scraped from the ship's anchor when the ship heaved anchor to move. The samples were sealed in plastic bags and returned to NAVOCEANO for size and composition analyses.

## V. DISPOSITION OF DATA

All serial-depth temperature and salinity data were forwarded to NODC. There, computer computations provided listings of temperature, salinities, sound velocities, and densities (sigma-t's) at observed and standard depths and specific volume anomalies at standard depths only. These data are in NODC under Reference No. 31S15. The ten BT slides taken from STAGE I are on file in NODC under Cruise No. 22823, and the 67 slides taken from GIBBS are on file under Cruise No. 22801. The bottom sample analyses are on file in NAVOCEANO under Laboratory Item No. 381. Original copies of velocimeter sound speed measurement records were retained by NRL.

## VI. PRELIMINARY ANALYSES

The water column in the area of STAGE I was continuously undergoing drastic changes during the 13 days the underwater acoustic experiment was being conducted.

At Nansen station 1 on 21 July, computed sound speed was 1540.6 m/sec at the surface, a maximum of 1542.8 m/sec at 43 feet, and a minimum of 1532.6 m/sec at 88 feet.

At Nansen station 12 on 31 July, computed sound speed was 1540.6 m/sec at the surface, a maximum of 1541.3 m/sec at 49 feet, and a minimum of 1525.9 m/sec at 88 and 93 feet.

Velocimeter sound speeds were compared with computed sound speeds and agreement was generally good. Because environmental conditions were changing continuously and simultaneous measurements of exactly the same water column could not be made, some variations were observed. Figures 2, 3, and 4 show typical velocimeter sound speed measurements and Nansen/BT computed sound speeds. Slight variations existed in the down and up velocimeter measurements, but greater differences occurred between measured and computed sound speeds.

Figures 5, 6, and 7 show typical BT traces. Figures 6 and 7 also show Nansen cast temperature/depth values.

Figures 8 and 9 present typical salinity profiles. These Nansen stations were taken with most bottles spaced at 3-meter intervals. Figures 10 and 11 present salinity profiles for Nansen stations 13 and 14, respectively, where two casts were taken at each station with several bottles spaced at 1.5-meter intervals. The greatest increase in salinity generally occurred between 40 and 60 feet.

## VII. ADDITIONAL DATA REQUIRED IN THE AREA

Sound speed values were obtained in support of this specific underwater acoustic experiment. If the experiment is conducted again, a velocimeter system with a depth sensor and continuous recording and printout capability should be used to obtain the sound speed profile.

## VIII. BIBLIOGRAPHY

Deep Ocean Surveys Division, 1967. Historical Environmental Data, Gulf of Mexico, Area 18. UNPUBLISHED MANUSCRIPT. U.S. Naval Oceanographic Office. Washington, D.C.

U.S. Naval Oceanographic Office, 1962. Tables of Sound Speed in Sea Water. Special Publication 58. Washington, D.C.

_____, 1968. Instruction Manual for Obtaining Oceanographic Data. Third Edition. Pub. No. 607. Washington, D.C.

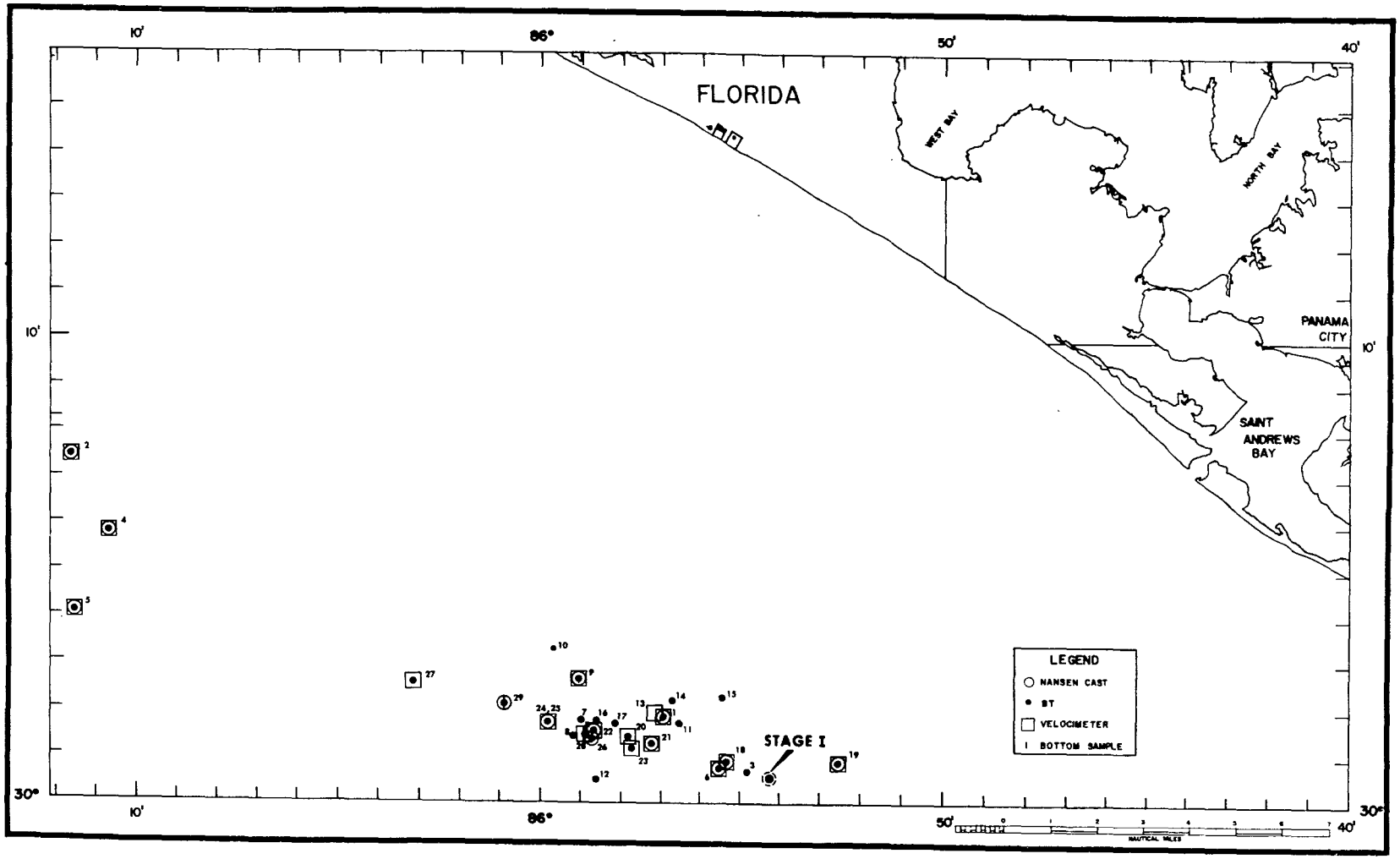


FIGURE 1. STATION LOCATIONS

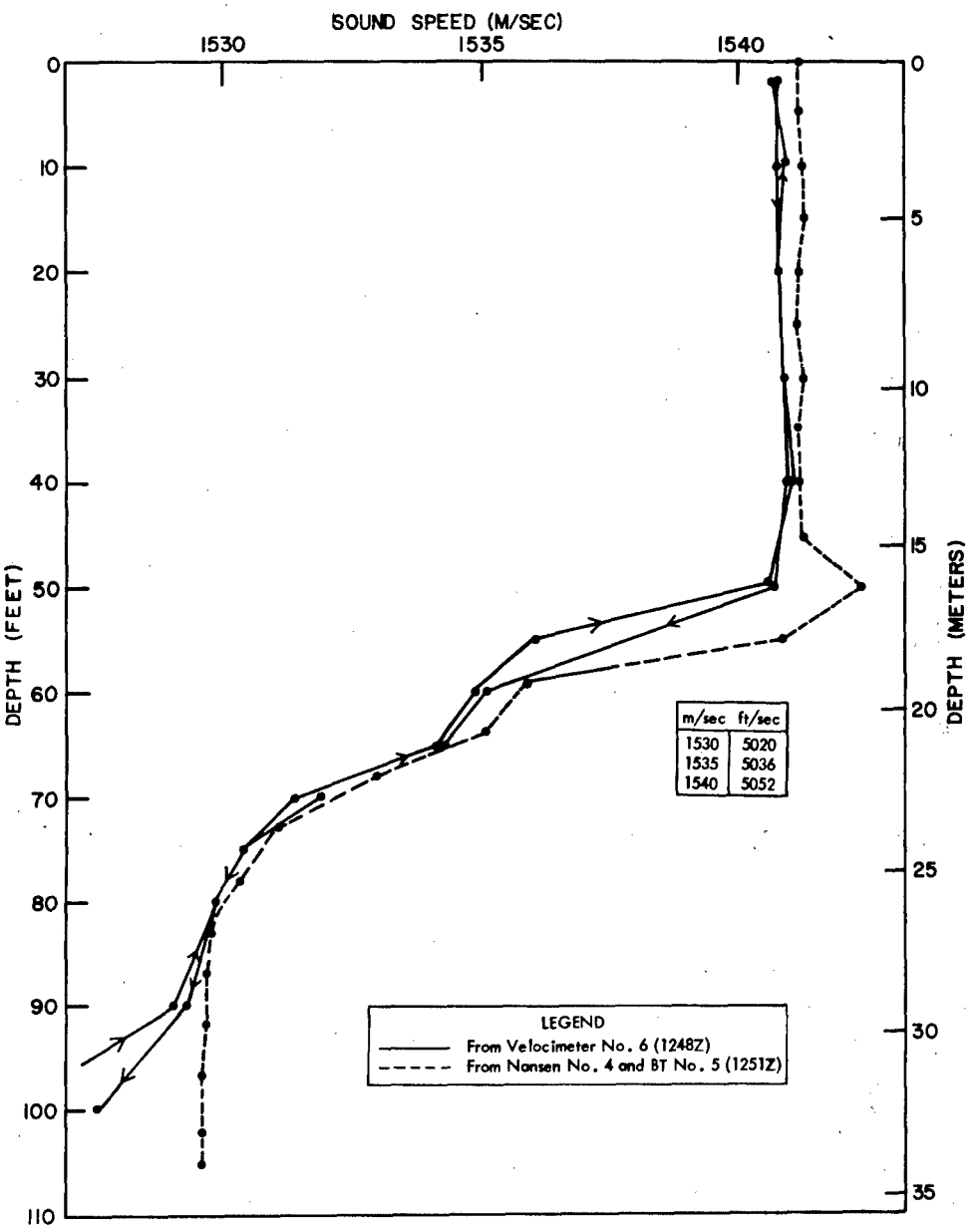


FIGURE 2. SOUND SPEED PROFILE - CONSECUTIVE STATION 5

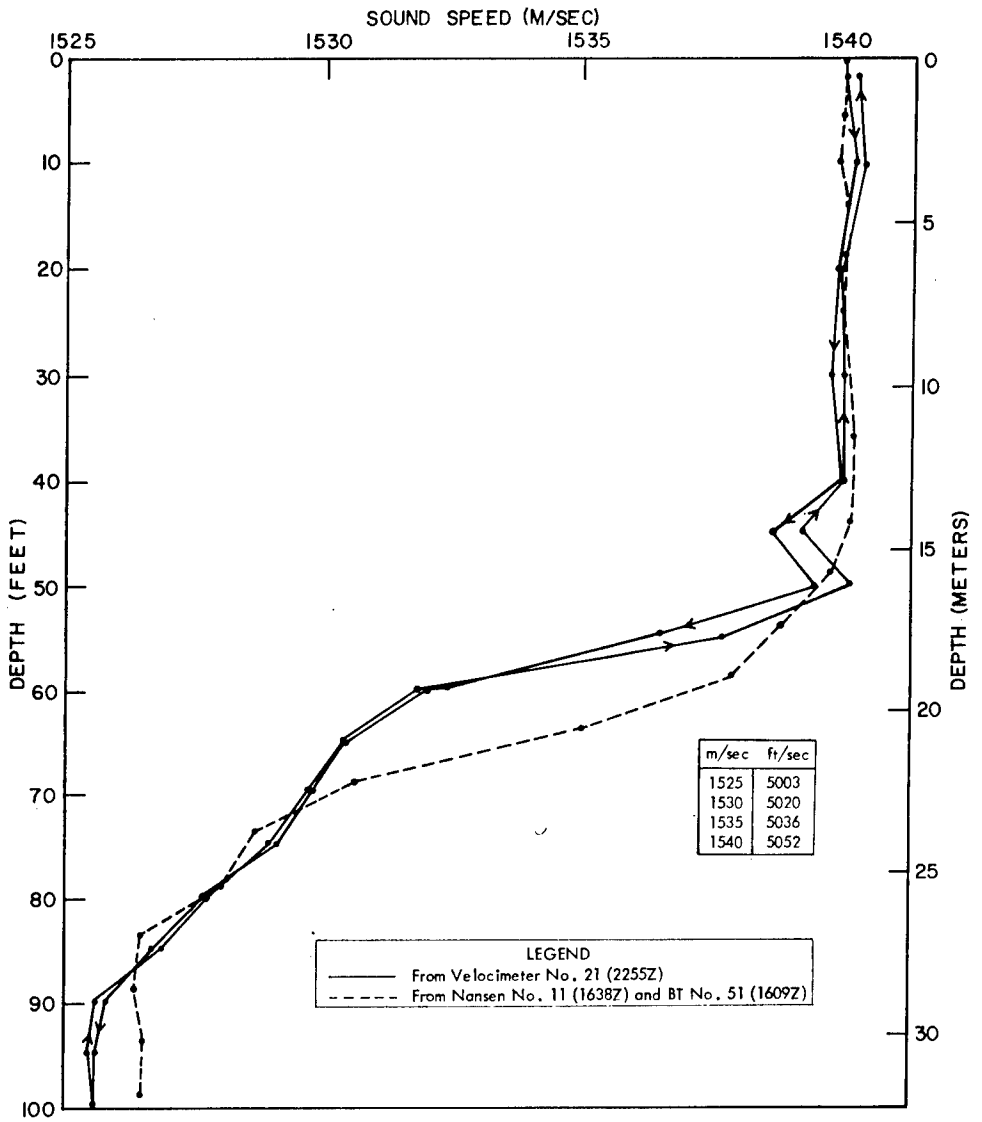


FIGURE 3. SOUND SPEED PROFILE - CONSECUTIVE STATION 24

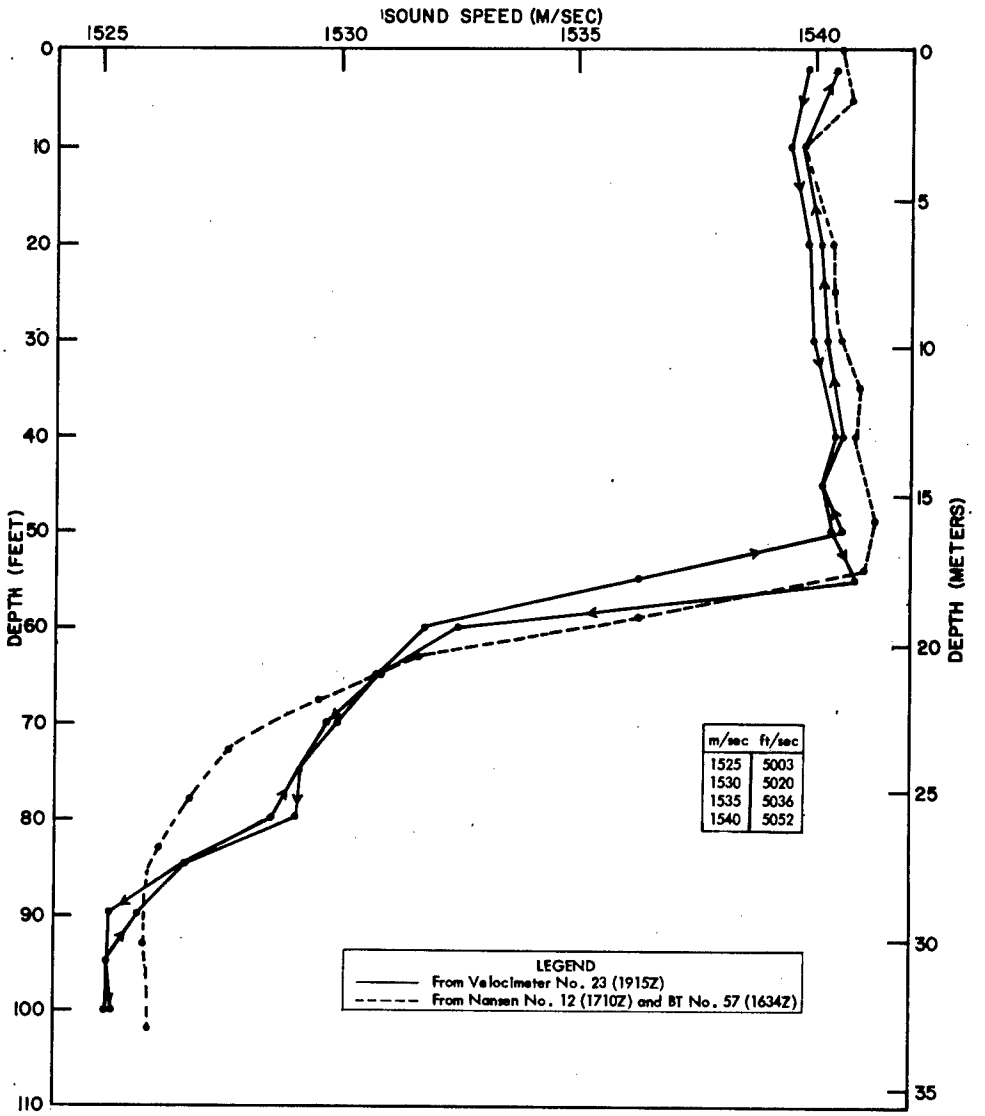


FIGURE 4. SOUND SPEED PROFILE - CONSECUTIVE STATION 25

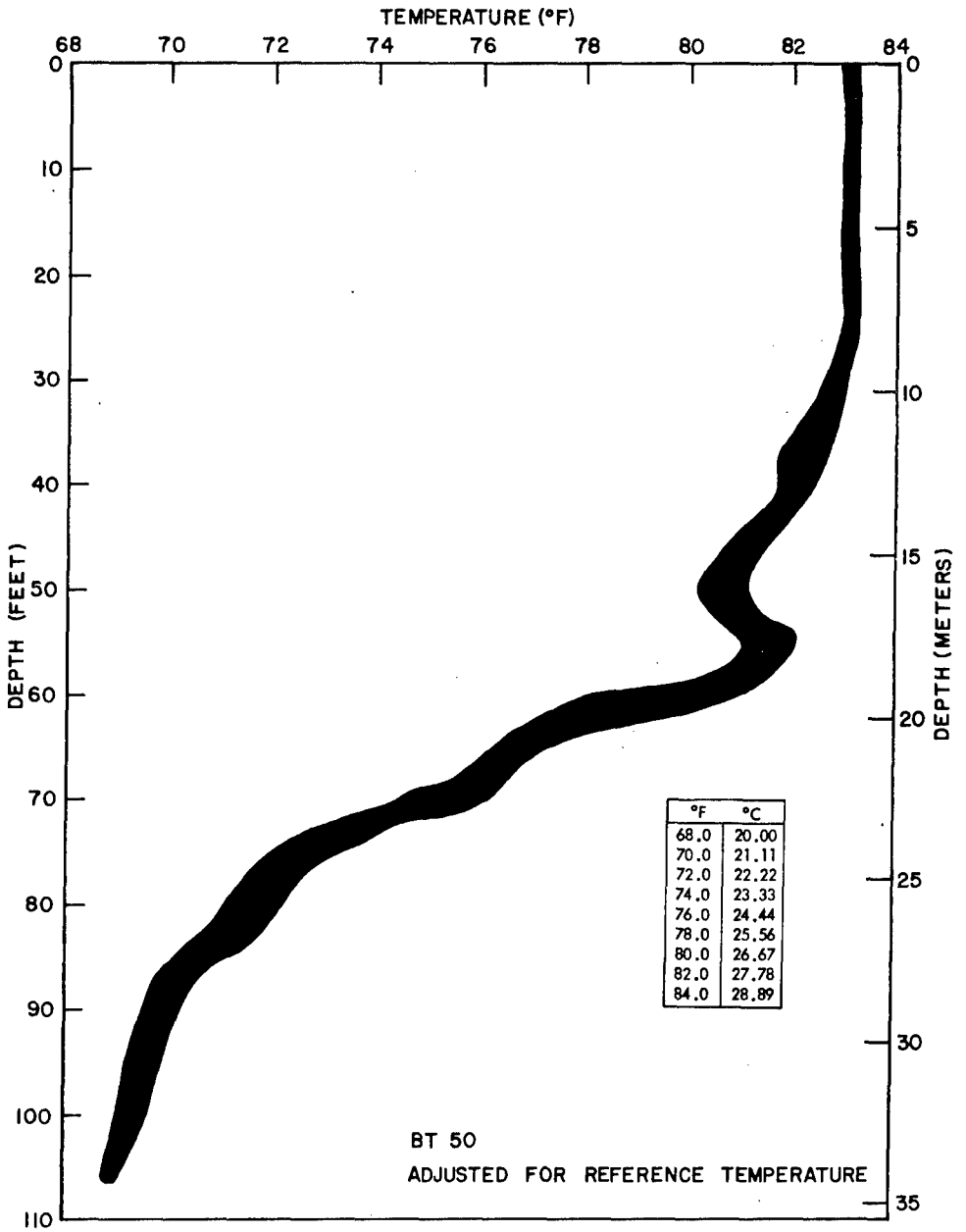


FIGURE 5. TEMPERATURE PROFILE - CONSECUTIVE STATION 23

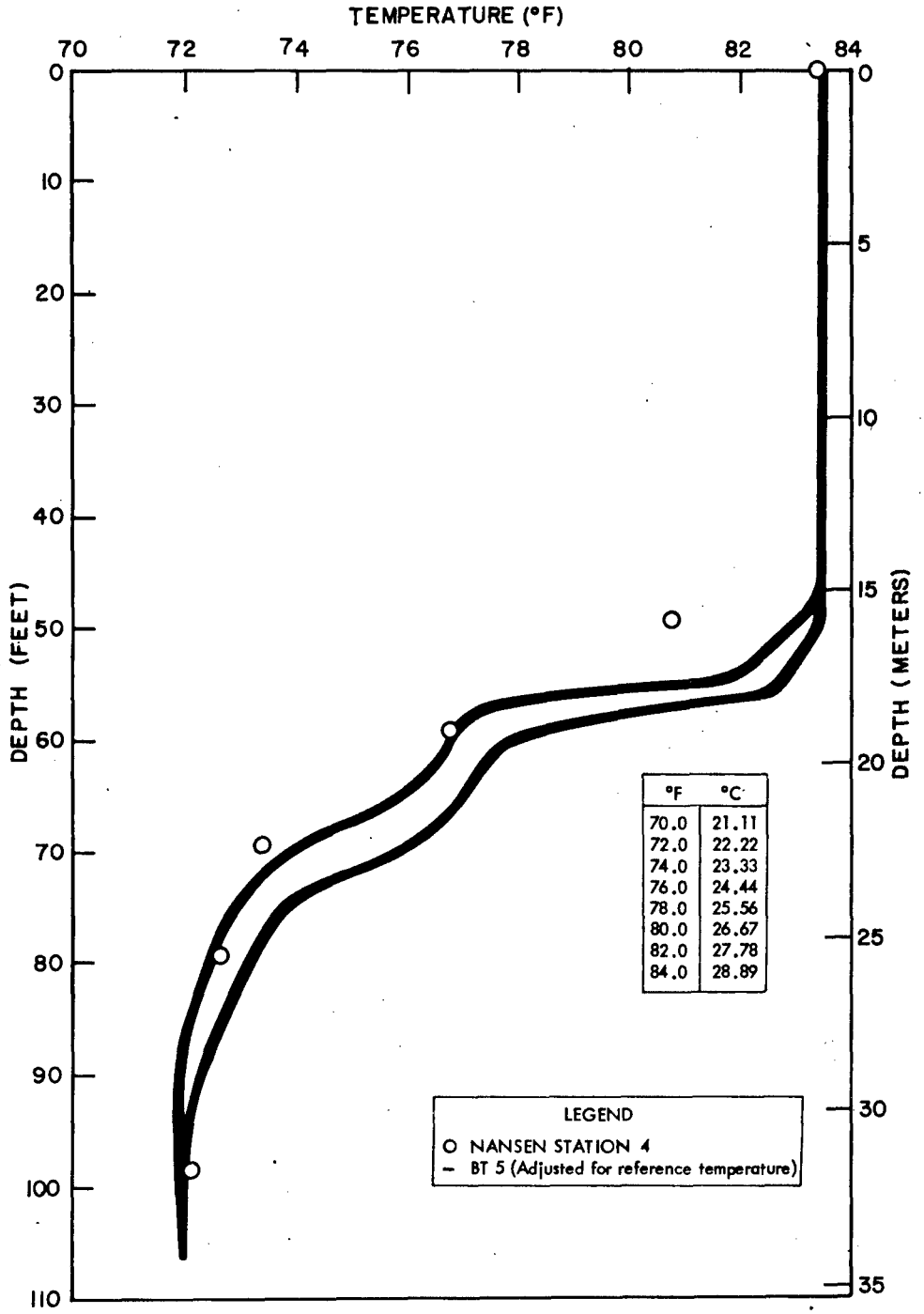


FIGURE 6. TEMPERATURE PROFILE - CONSECUTIVE STATION 5

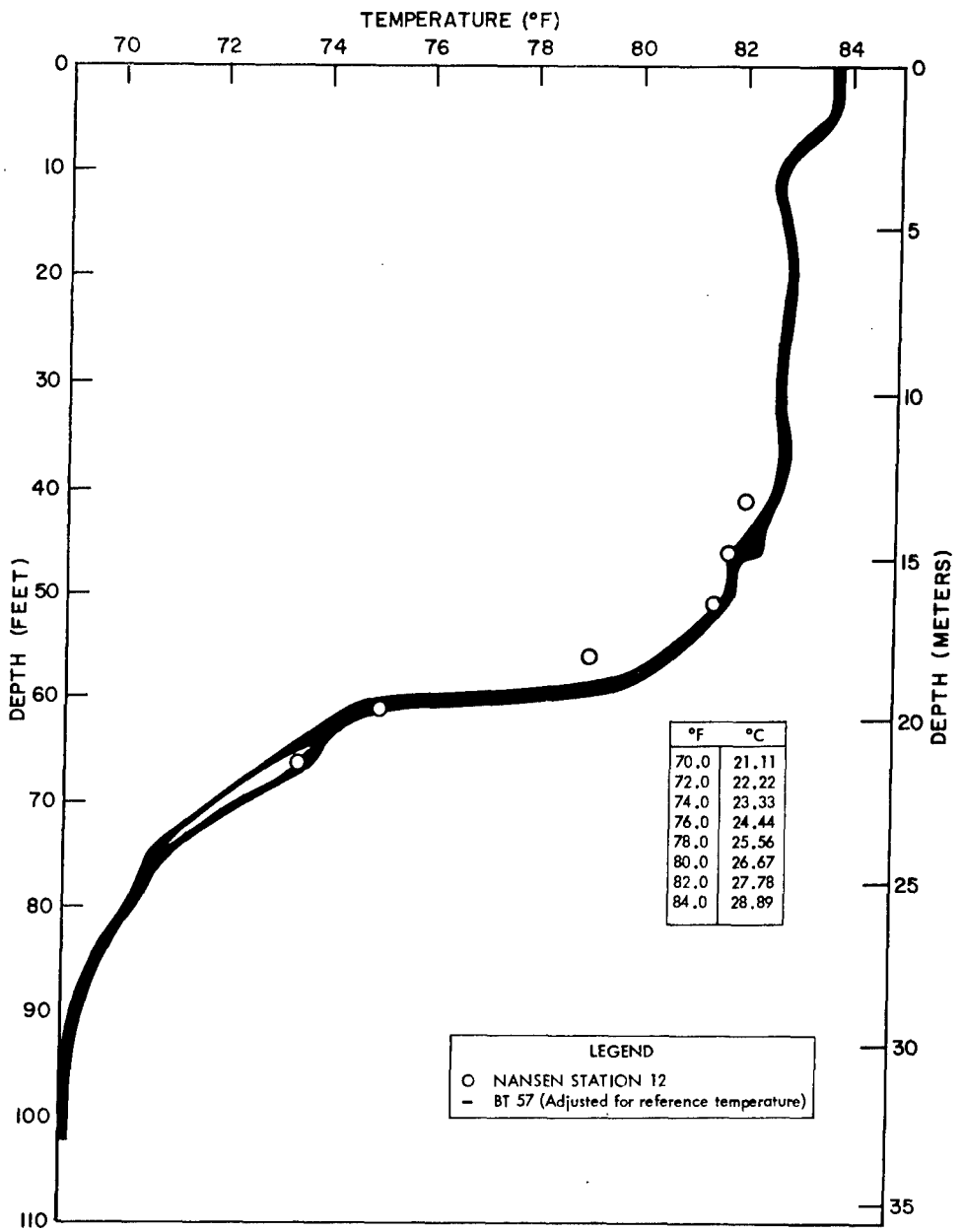


FIGURE 7. TEMPERATURE PROFILE - CONSECUTIVE STATION 25

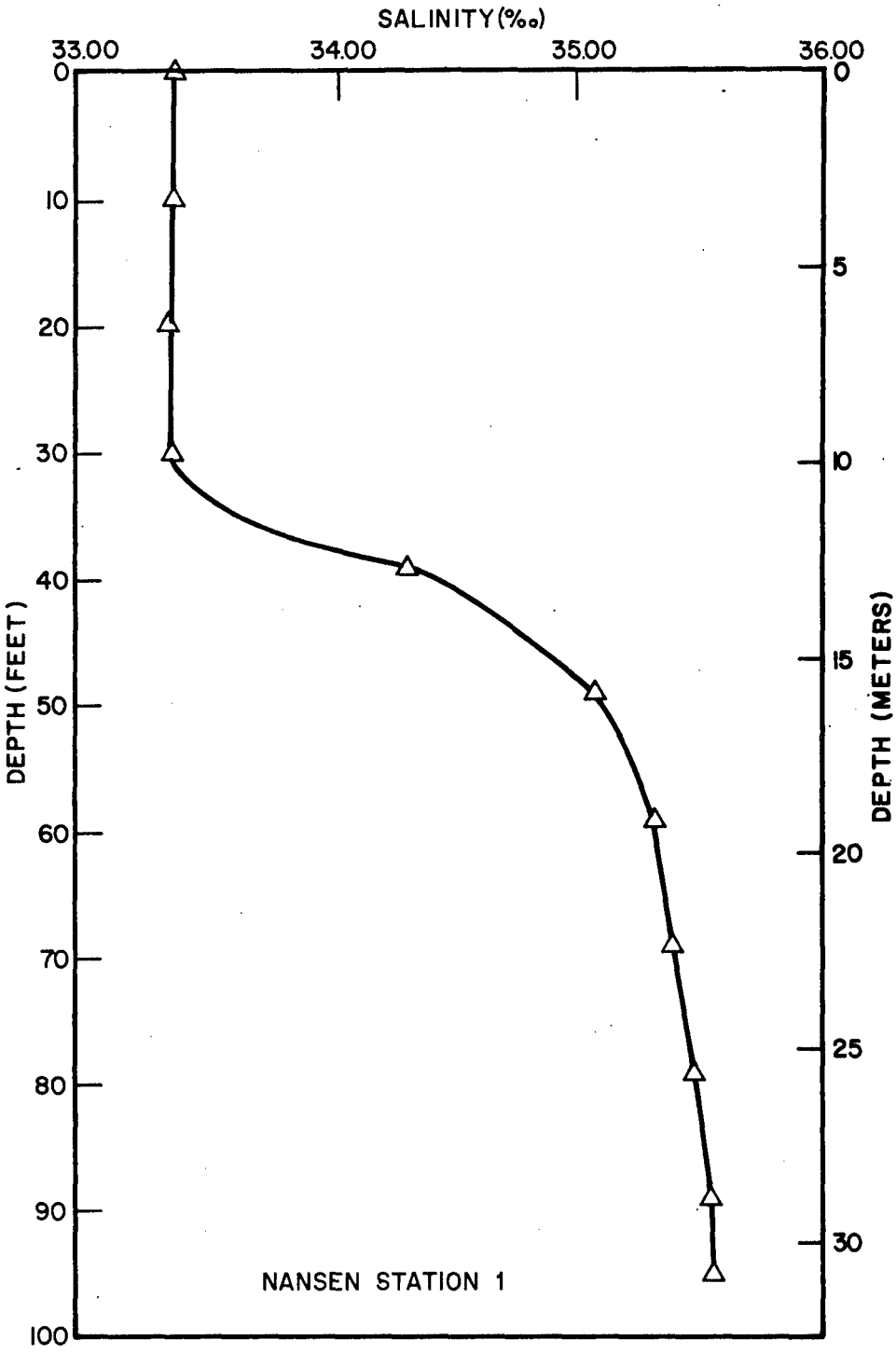


FIGURE 8. SALINITY PROFILE - CONSECUTIVE STATION 1

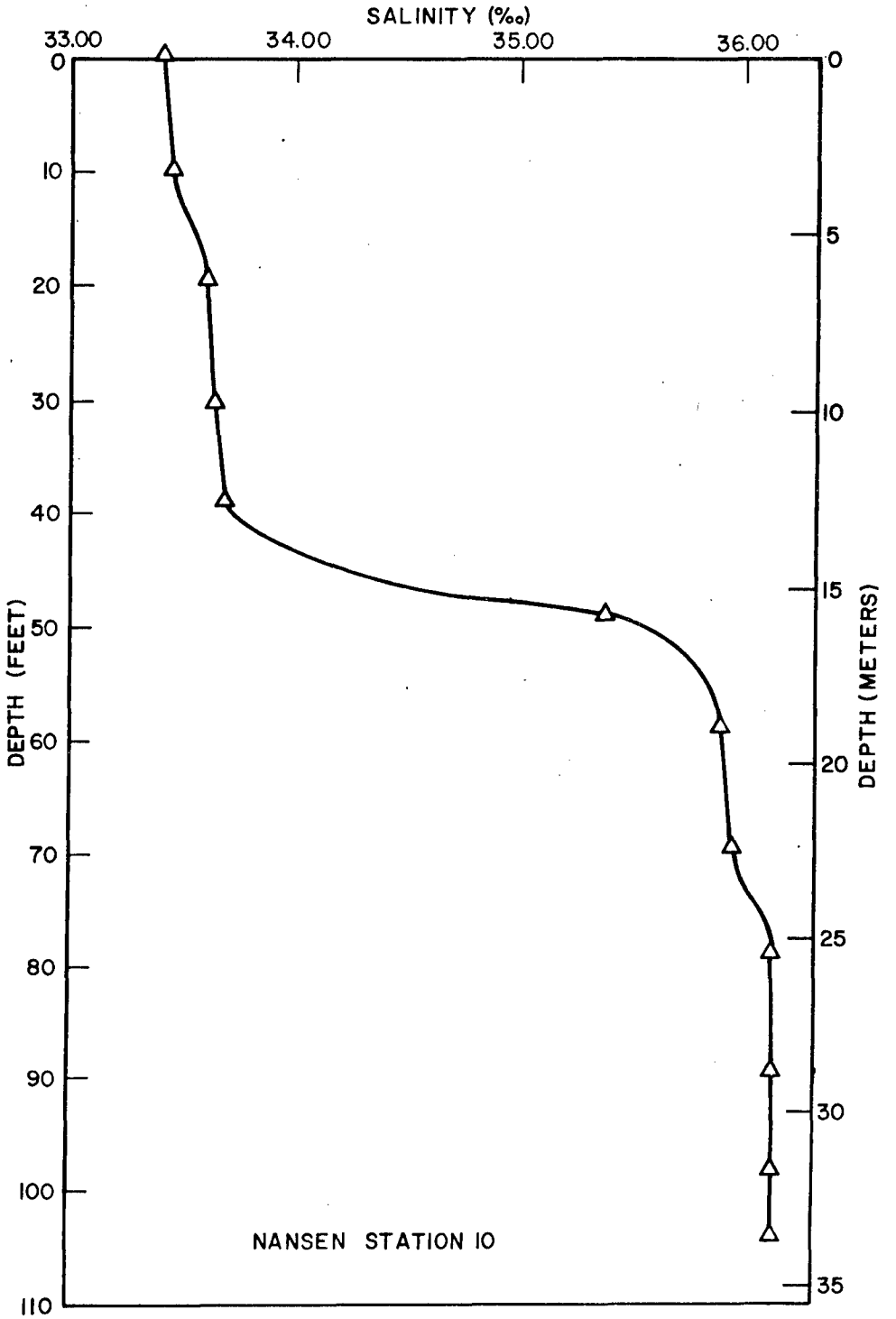


FIGURE 9. SALINITY PROFILE - CONSECUTIVE STATION 22

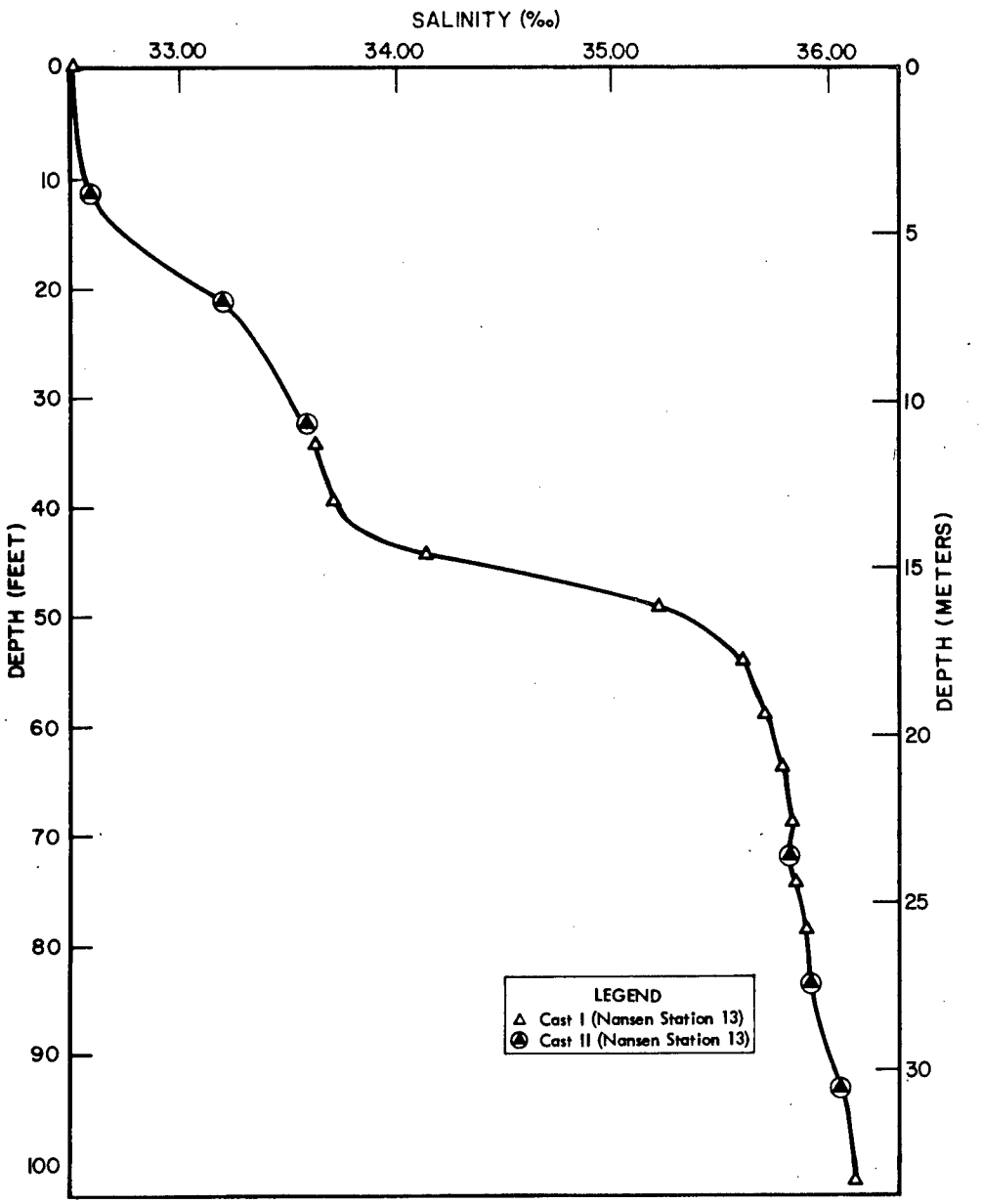


FIGURE 10. COMPARATIVE SALINITY PROFILES - CONSECUTIVE STATION 26

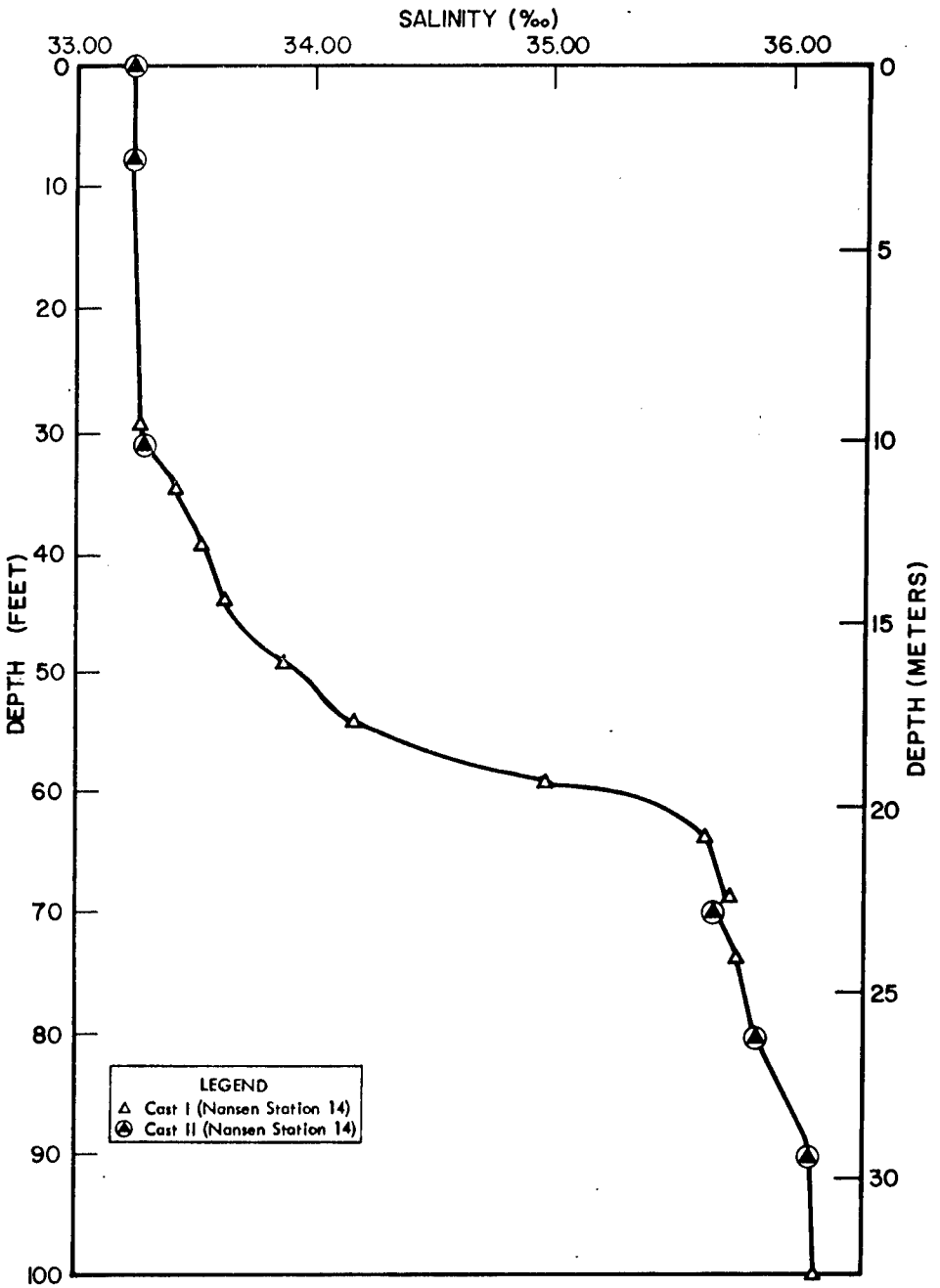


FIGURE 11. COMPARATIVE SALINITY PROFILES - CONSECUTIVE STATION 29

TABLE I. OCEANOGRAPHIC STATION DATA COLLECTION SUMMARY

| Consec. Sta. No. | Nansen Sta. No. | Latitude (°N) | Longitude (°W) | To STAGE I * range (nm) | bearing | Sonic Depth (m) | Cast Depth (m) | Rev. Therm. Temps. | Salinity Samples | BT No. ** | Bottom Sample No. | Velocimeter Lowering No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 30°02' | 085°58' | 2.7 | 119° | 31 | 29 | 2 | 11 | 1 | | 1,2,3 |
| 2 | 2 | 30°08' | 086°11' | 16.8 | 115° | 32 | 29 | 2 | 11 | 2 | | 4 |
| 3 | | 30°01' | 085°55' | | | | | | | 3 | | |
| 4 | 3 | 30°06' | 086°11' | 15.2 | 110° | 31 | 29 | 3 | 11 | 4 | | 5 |
| 5 | 4 | 30°04' | 086°11' | 15.5 | 103.5° | 33 | 32 | 6 | 12 | 5 | | 6 |
| 6 | 5 | 30°01' | 085°56' | 1.0 | 102° | 32 | 27 | 2 | 2 | 6,7 | | 7 |
| 7 | | 30°02' | 085°59' | 4.3 | 105° | | | | | 8,9 | | |
| 8 | | 30°02' | 085°59' | 4.4 | 102° | | | | | 10-14 | | |
| 9 | 6 | 30°02' | 085°59' | 4.7 | 117° | 31 | 30 | 6 | 12 | 15 | | 8 |
| 10 | | 30°03' | 086°00' | 5.5 | 121° | | | | | 16 | | |
| 11 | | 30°02' | 085°57' | 2.3 | 120° | | | | | 17 | | |
| 12 | | 30°01' | 085°59' | 3.8 | 089° | | | | | 18 | | |
| 13 | | 30°02' | 085°58' | 2.8 | 119° | | | | | | | 9 |
| 14 | | 30°02' | 085°57' | 2.7 | 128° | | | | | 19 | | |
| 15 | | 30°02' | 085°55' | 2.0 | 149.5° | | | | | 20 | | |
| 16 | | 30°02' | 085°59' | 4.0 | 108° | | | | | 21,22 | | |
| 17 | | 30°02' | 085°59' | 3.6 | 109° | | | | | 23,24 | | |
| 18 | 7 | 30°01' | 085°55' | 1.0 | 110° | 31 | 30 | 6 | 11 | 25,26 | | 10 |
| 19 | 8 | 30°01' | 085°53' | 1.5 | 257° | 31 | 30 | 6 | 11 | 27,28 | | 11 |
| 20 | | 30°01' | 085°58' | 3.2 | 106° | | | | | 29-33 | | 12,13 |
| 21 | 9 | 30°01' | 085°58' | 2.7 | 106° | 33 | 32 | 6 | 12 | 34-45 | | 14-18 |
| 22 | 10 | 30°02' | 085°58' | 4.0 | 105° | 33 | 32 | 6 | 12 | 46-49 | | 19 |
| 23 | | 30°01' | 085°58' | 3.1 | 102° | | | | | 50 | | 20 |
| 24 | 11 | 30°02' | 086°00' | 5.0 | 104° | 32 | 31 | 6 | 12 | 51-54 | | 21,22 |
| 25 | 12 | 30°02' | 086°00' | 5.0 | 104° | 32 | 31 | 6 | 12 | 55-59 | | 23,24 |
| 26 | 13 | 30°01' | 085°59' | 4.0 | 103° | 33 | 32 | 6 | 18 | 60-62 | | |
| 27 | | 30°03' | 086°03' | 8.0 | 105° | | | | | 63,64 | | 25 |
| 28 | | 30°02' | 085°59' | 4.1 | 103° | | | | | 65 | 1 | 26 |
| 29 | 14 | 30°02' | 086°01' | 6.0 | 105.5° | 31 | 30 | 6 | 17 | 66,67 | 2 | |

* Range and bearing are considered more accurate than latitude and longitude

** 10 additional BT's were taken by NRL on Stage I

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| 14. KEY WORDS | LINK A | | LINK B | | LINK C | |
|---|---|---|---|---|---|---|
| | ROLE | WT | ROLE | WT | ROLE | WT |
| OCEANOGRAPHY | | | | | | |
| PANAMA CITY | | | | | | |
| SOUND SPEED | | | | | | |
| USNS J.W. GIBBS (T-AGOR 1) | | | | | | |